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THE RANGE CRANE-FLIES IN CALIFORNIA

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Scientific Assistants, Cereal and Forage Insect Investigations

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THE RANGE CRANE-FLIES IN CALIFORNIA.[1]

NATURE AND EXTENT OF INJURY.

California ranges, pastures, and grain and alfalfa fields are often badly injured during the rainy season by blackish, mud-colored, wormlike maggots from one-half inch to 1 inch in length. The maggots are the young, or larvæ, of crane-flies, *Tipula simplex* and *T. quaylii* Doane. The adult flies, called by different names in different localities, are the fragile, long-legged, two-winged insects which look like, but are much larger than, mosquitoes and which *do not bite.* A peculiarity of the species under discussion, however, is that the female *simplex* and both male and female *quaylii* are practically wingless. These wingless forms resemble spiders, or daddy-long-legs,

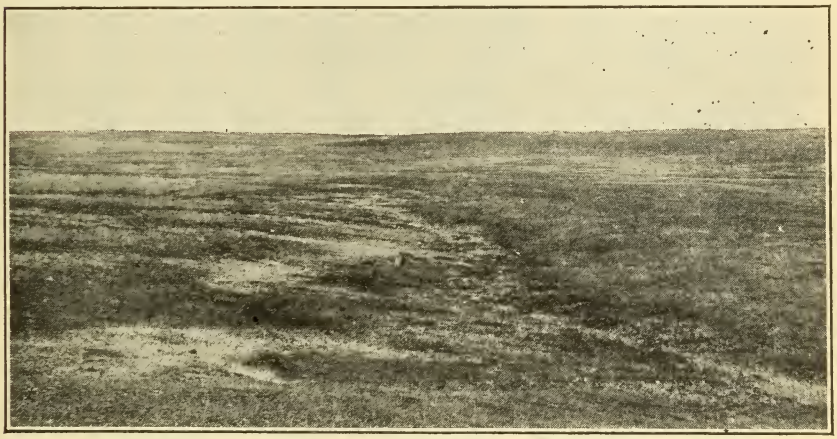

FIG. 1.—Injury by the range crane-flies (*Tipula simplex* and *T. quaylii*) to pasture in California.

more than they do flies. They are inconspicuous as they crawl about on the ground, so that the winged male of *simplex* is the only form commonly noticed by the farmer. The maggots become exceedingly abundant in spots, sometimes as numerous as 300 to the square foot, and devour all the vegetation or grain in these areas. (Fig. 1.) The injury they do is usually more noticeable during wet winters such as that of 1920–21; but they occur in injurious numbers almost every winter in some locality or other, and a few usually can be found every winter throughout the area inhabited by the insect. On large areas of range land the maggots often destroy in a single year thousands of dollars worth of forage, for lack of which the live stock sometimes die of starvation. In addition, they are likely to attack

[1] *Tipula simplex* Doane and *T. quaylii* Doane; order Diptera, family Tipulidae.

almost all winter-planted field crops, especially when these are on newly broken sod land where the flies have had an opportunity to breed and multiply undisturbed during several successive seasons.

HABITS.[2]

The maggots of the range crane-fly are hatched with the first heavy rains of winter just as the grasses are sprouted by these rains. The eggs from which they hatch were laid late in the previous winter and remained dormant in the soil throughout the intervening dry season. At first the effect of their feeding is not noticeable, but as they increase in size their appetites also increase, and to such an extent that by January it takes about all the available pasture to furnish sufficient food for the multitude of maggots present in the spots where they are most abundant. By the end of January, or in early February, they become full grown, stop feeding, and begin the change to adult flies by entering the pupa stage. They change to the adult form in much the same way as caterpillars develop into butterflies. There is only one generation a year; hence when the maggots begin to pupate, in January or February, depending on the season, no further injury from this species need be feared during the remainder of the growing season. The maggots change to pupæ just below the surface of the soil, and the adults come out in late February or in March, depending on the weather conditions prevailing in different localities and seasons.

FIG. 2.—Eggs of the range crane-fly *Tipula simplex* beside a common pin. Five and one-half times natural size.

A peculiarity of this species is that the females are wingless, although the males have one pair of wings and can use them. The females, therefore, lay their eggs within a few rods of the spot where they emerge from the ground. The eggs are deposited within a day or two after the adults emerge, in depressions in the soil, under the edges of loose stones, under clods, and among grass roots, and here they lie dormant throughout the ensuing dry season, to hatch the following winter as soon as they are thoroughly soaked by the

[2] These remarks apply to *Tipula simplex* only, although the habits of *T. quaylii* are very similar.

first rains. Each female is capable of laying approximately a hundred eggs, and dies very soon after this function is performed.

DESCRIPTION.[3]

The eggs (fig. 2) are dull brown when dry, black when wet, ellipsoid in shape, about one thirty-second inch in length by one sixty-fourth inch in diameter, the surface of the shell being slightly roughened. They are placed in small masses mixed with the soil by the adult.

The larvæ (fig. 3, *a*, *b*) are not commonly observed until they are nearly or quite full grown. When nearly mature they are one-half inch to 1 inch long, one-eighth inch or less in diameter, and dark brown. The shiny, black head is small in proportion to the body, being about one-third as wide, bears a pair of very short antennæ, or feelers, and the mouth parts are fitted for biting or chewing. The larvæ are able to retract the head until it is completely out of sight, and do so when picked up or disturbed. The tail end bears several short, pointed protuberances arranged in a sort of radial or star-shaped form, the four upper ones being the most prominent.

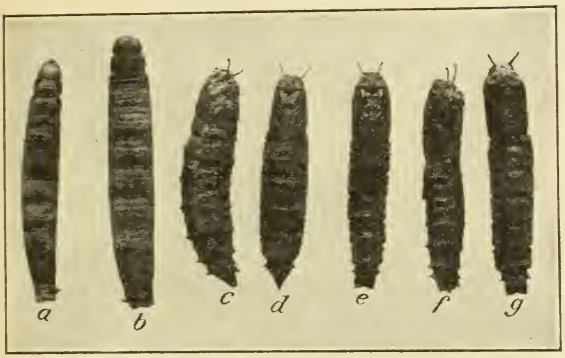

FIG. 3.—Larvæ and pupæ of the range crane-fly *Tipula simplex*: *a*, Larva, ventral view; *b*, larva, dorsal view; *c*, female pupa, side view; *d*, female pupa, ventral view; *e*, male pupa, ventral view; *f*, male pupa, side view; *g*, male pupa, dorsal view. Enlarged.

The pupæ (fig. 3, *c–g*) average about five-eighths inch in length and are the same color as the larvæ. Each pupa has a pair of breathing tubes, less than one-sixteenth inch long, which look like short antennæ extending forward from the head. Pupæ from which female flies will emerge are more robust and have a more pointed tail end than those which develop into males. The little cases in which the wings and legs of the future adult are forming may be seen folded flat against the thorax. Pupæ which will develop into females have smaller wing pads and shorter leg cases than those containing males. Each abdominal segment of both the male and female pupa bears a single ring of small, backward-curving spines. Several larger ones occur on the tail end. Immediately before pupating, the mature

[3] The paragraphs under this heading describe the stages of *Tipula simplex* Doane, although in its life history and general appearance *T. quaylii* is very similar. As stated before, however, the adults of both sexes of *T. quaylii* are wingless.

larva usually forms an upright cell, with its upper end at, or just below, the surface of the soil, so that the pupa is in a vertical position, with its head close to the surface of the ground. When the adult is ready to emerge from the pupal skin, the pupa wriggles its way upward by means of its spines until it protrudes part way from the soil. The adult then bursts through the thorax of the pupal skin and crawls out, leaving the empty case still standing partly in the cell, or entirely exposed on the surface of the ground.

The adult flies (fig. 4) are dull brown in color, the females being somewhat darker than the males. Their slender bodies are from one-half to five-eighths of an inch in length, and the wing spread of the males is about seven-eighths of an inch. Instead of wings, the female (fig. 4, *b*) has a pair of inconspicuous stubs on the thorax. The legs of the female are about the same length as the body, stouter, and better fitted for walking than those of the male (fig. 4, *a*), which are very fragile and about twice the length of the body. The abdomen of the female is larger than that of the male, but more tapering, ending in a hard, sharp-pointed organ consisting of four valves, used in penetrating the soil for egg laying. The male abdomen is slender, curving slightly downward and then upward at the end, where it is somewhat enlarged, and bears several pairs of lobe-like appendages used in mating. In the early spring the adults become very numerous in the areas where the maggots were injuriously abundant the previous winter. They are not readily seen, however, especially the females, because their color so closely matches that of the soil. When disturbed the males fly a few feet and then remain motionless upon alighting. The females are not so easily frightened, especially when laying eggs, but crawl away quite rapidly when molested, or when searching for a suitable place to lay eggs.

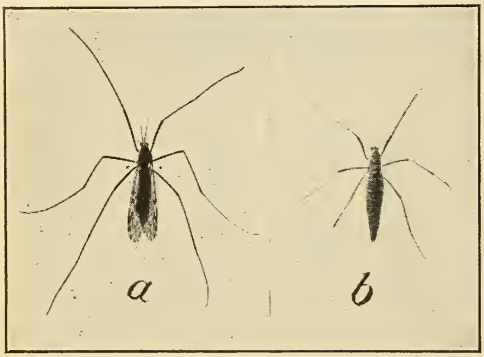

FIG. 4.—Male (*a*) and female (*b*) adults of the range crane-fly *Tipula simplex*. About natural size.

CONTROL.

Cultivation.—Heretofore the only known method of reducing injury by these species has been more or less continuous cultivation. This method of control is of no avail to save a crop which already has been planted and which actually is being destroyed before one's eyes by the pest. Cultivation can only forestall possible injury in

future years and can not be applied at all to large areas of range land. As previously stated, also, grains and young alfalfa are often injured by the maggots and the problem has been to find an immediate remedy which is applicable where they are in the very act of destroying crops or pasture. A practical solution of this problem has been attained, the writers believe, in the use of a poisoned-bran bait.

Poisoned-bran bait.—It was observed by the junior writer that the crane-fly maggots usually come out upon the surface of the ground

FIG. 5.—Typical appearance of surface of plots on which poisoned bait had been distributed. All range crane-fly larvæ in the photograph are dead and have not been disturbed from the position in which they died.

during the night. This fact, together with the indication that this species feeds upon aerial or above-ground portions of the plants much more than is commonly supposed, suggested the possibility that they would be attracted by the poisoned-bran bait commonly used for grasshoppers. During the winter of 1920–21 experiments were conducted in heavily infested areas to determine the efficiency of poisoned-bran baits as remedies for the insects. As a result, from 50 to 90 per cent of the maggots were killed on experimental plots where several different poisoned-bran formulas were tried. (Fig. 5.) The mash usually recommended for grasshoppers, containing molasses and lemons added to the bran, Paris green, and water, killed an average of

72 per cent of the total number of maggots present. Fully as high a percentage of mortality, however, was obtained on the plots where a mixture of bran, Paris green, and water, without any of the flavorings, was distributed; and since this is cheaper and considerably easier to mix, a bait made in the following proportions is recommended:

Bran	pounds	25
Paris green	pound	1
Water to make a flaky mash	gallons (about)	3

Mix the Paris green into the dry bran thoroughly. Then gradually add water until an even, crumbly mash is obtained. Apply 10 to 20 pounds per acre broadcast by hand, or with a broadcast grain seeder mounted on a wagon in the usual way.

The bait can be mixed in a large box, tub, or trough, or on a large piece of canvas. Where an area of considerable size is to be covered, the bait can be spread very easily and rapidly with a horse-drawn grain seeder. Ten to twenty pounds per acre was the smallest amount which gave a uniformly high percentage of kill over the entire plot. Where smaller amounts were used the percentage of mortality varied greatly on different parts of the plot because of the difficulty of making an even distribution of the bait. Amounts larger than 20 pounds per acre did not increase the effectiveness of the bait. When this is evenly and smoothly spread with a grain seeder, effective results probably can be attained with smaller amounts than if more or less unevely sown by hand. The poison should be sown broadcast over the entire infested area, rather than in strips, because this insect ordinarily does not travel far in search of food.

The cost of this poison, applied as recommended above, is about 50 cents per acre, not counting the labor of mixing and spreading. The ingredients can be purchased almost everywhere. Prompt application of this poison should enable growers to save its cost many times over in increased yields of grain and pasture forage. Not only may the crop of the current year be saved, but the number of worms likely to hatch and do damage the following year undoubtedly may be considerably reduced. Especially close watch should be kept during the early winter on grains and alfalfa planted on newly broken sod lands, so that the maggots, which are always likely to be very abundant in such fields, may be poisoned before they can do serious injury to the crops. It is believed that the use of poisoned-bran bait offers a cheap, practical, and effective remedy which can be applied easily to the crops injured by the maggots of the range crane-fly.

Precautions should be taken not to allow the poisoned bait to fall in lumps when spreading it in the fields, and to avoid leaving quantities of it in places where children or animals can have access to it. This bait has been spread many times where cattle and sheep were grazing, with absolutely no injury to the stock.

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